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Average Spillages and Water Balance in Somes Plain

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Abstract

This article aims to analyze data on water balance of Somes Plain, study based on data from the period 1979-2010. Were analyzed the quantities of water entering and leaving the area in a period of time, taking into account climatic factors, location, season etc . Geographical location from the northwest of Romania, in the interior of Carpathian Mountains, in northeastern of Tisa Plain and belonging to the general atmospheric circulation throughout the European space are thus the main elements of position that determine the climate of Someş Plain.

The general circulation of air masses is determined by atmospheric action centres that are characteristic for this part of Europe (Azores anticyclone, Iceland cyclone, Greenland anticyclone, Mediterranean cyclones and North African anticyclone), which in one way or another, affect plain climate at various times of the year.

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1. Introduction

Average leakage is the general indicator of water resources in rivers, providing the measure of water potential of the rivers from a given region. Knowing the average flow values is particularly important in all studies designed to investigate the possibilities of rational use of water in various socio-economic goals.

2. Material and Methods

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The Someş River is included by the hydrologists in the group of rivers from west on the Romanian territory to which the rivers Mureş, Criş, Barcău, Crasna, also belong. The whole draining system of the Someş takes up a surface of 15 217 square km and is registered on a length of 345 km.

The medium altitude for the whole hydro graphic basin is of 540.41 m. The reference of the length of river network from the basin (9257.11 km) to its surface reveals a medium density of 0.59 km/km². The differences appear between the morphologic drained areas, respectively: 0.7-1.1 km/km² in mountain area; 0.4-0.7 km/km² in the Transylvanian Plain and the Someş Plateau; 0.1-0.3 km/km² in the plain low area (see Fig. 1).

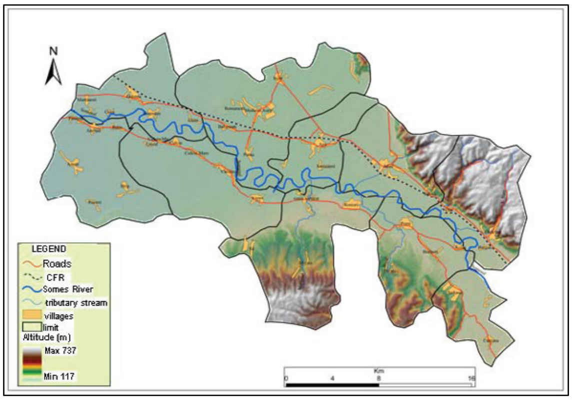

Fig. 1. The settlements along the Someş Valley and the confluence with the Lăpuş River and Satu Mare village.

The notion of *"hydric balance"* shows the quantitative relationship between the quantities of water entering and leaving the area in a period of time. The difference between the volumes of water in and out of this system reserve of water in that area consists of water from rivers, underground water and soil moisture layers [1].

In determining the fluid balance of a complex equation using average values for the period, expressed in *mm,* the main constituent parts are represented by elements of the water cycle. Thus, **the positive part of fluid balance** is the *rainfall* and *evapo-transpiration* is the **negative,** *leakage* and *losses otherwise.*

In the *structure* of *hydric balance* is included the*,* **rainfall** *(X),* which is consumed in the formation **of surface flow** *(S)* and **underground** *(U)* and **evapo-transpiration** *(Z).* Water resources remained in catchments basins after the formation of surface flow represents **the total land wetting** *($W = U + Z$).* In turn, surface and underground drainage form global flow *($Y = S + U$).*

The sediments transport represents an important element in the equation result of the river bed processes. Connected to the sediments flow on the Someş River, there appear frequent anomalies of the relationship river flow–sediments transport, in the sense that the positive alluvial deposit is registered in intervals of reduced flow (e.g. summer and autumn) and the negative balance corresponds to the periods with augmented flow (spring). The Someş River transport considerable amounts of alluvial deposits through suspension, dragging, rolling and leaping.

Evaluation of average annual values of hydric balance components was based on the mathematical model represented by the differential equation developed by ***M. I. Lvovici:*** $Xo = Yo + Zo$; $Xo = So + Wo = So + (Uo + Zo)$, applied to data derived from measurements and measurements in the range 1979 - 2010, carried out in the hydrological and meteorological network of Somes Plain and from the surrounding areas of the two counties Satu Mare and Bihor.

In the analysis of average flow were used observation data from 9 hydrometric stations, which controls the river basins whose altitude varies between 251 and 534 m, and the area between 36.6 km² and 15 600 km².

The election of period for calculating the average flow has been considered several criteria, namely: establishment features hydrometric data string, the precision required for knowledge and variability of data strings.

Representative string data was analyzed based on flows determined over a period of 31 years in the sampling points of dates in the studied area, choosing to calculate the average flow during this period, it presents several advantages: data string length is sufficient; maximize existing hydrometric data, including the most recent and reliable, have the lowest average flow errors and coefficients of variation falling within acceptable limits.

In quantitative flow characterization are used multiple terms: average flow *(Q - m³/s),* flow or average specific leakage *(l/s/km²),* flow volume *(V - million m³)* and leakage layer height (*Y - mm).*[3]

Because the hydrological network from Somes Plain is in small percent aborigine, the main rivers coming outside of this to characterize the water resources across plains and to compare this with other neighbouring geographic units is used the specific discharge average, which is the amount of water flowed on the area unit (km²) within one second (s). It is obtained by reporting the river flow in a given point on the surface to the related pool. The values obtained were correlated with morph metric elements of the catchments. The closest correlations were obtained with an average altitude, allowing generalization of average annual flow territorial values [2].

Increasing flow while increasing relief altitude highlights different weight of the relief levels to achieve the medium flow volume of liquid leakage (Table 1) [4].

Table 1. The distribution of average annual flow on altitude intervals from Someşului Plain

Altitude intervals (m)	**Q (m^3/s)**	**q (l/s.km^2)**	**V (million m^3)**	**Y (mm)**	**% of drained water**
98-100	0.031	1.90	0.979	59.9	0.4
101-150	7.059	2.18	222.597	68.7	89.1
151-200	0.760	2.08	23.954	65.5	9.6
201-250	0.070	2.36	2.199	74.4	0.9
Total	**7.919**	**4.435**	**249.728**	**68.3**	**100.**

Mean flow values vary from year to year depending on climatic factors oscillation, being different from one river to another and from one region to another. The amplitude of variation of annual flow is determined both by climate characteristics and primarily humidity and surface watershed, which play an important role in regulating flow.

For a more detailed characterization of flow from year to year were used variation and asymmetry coefficients. To outline the areas with the highest and lowest annual average discharge were used module coefficients of annual mean flow from nine stations, most representatives in Someş Plain.

Following the chronological variation of the average annual flow for the period 1979 - 2004 for all nine hydrometric stations in the relevant catchments across the main rivers of Someş Plain, it is noted that the richest leak was in 1980.

The years with the lowest flow in the aforementioned period were 1985 and 1995 in the Ierului basin, 1990 for the Turu, Somes and Crasna basin, 1992 and 1994 for Someş basin and 2003 for Turu and Somes basin. The minimum calculated value of the annual flow mode coefficient in was recorded in 1985, on the river Santau, at the Morii Valley. The corresponding values for this years have reached the order of several liters (0.001 m^3/s on Santau at Morii Valley, 0.001 m^3/s at the Vinului Valley, 0.002 m^3/s on Turt at Gherța Mare, 0.097 m^3/s on Talna at Pasunea Mare, or 0.000 m^3/s at the Vinului Valley in 1992 and 1994, and on Turt at Gherta Mare in 2003, when the rivers have dried up.

From the measurements and calculations made at the hydro-metric stations, it was found that the largest amplitude is found in large rivers of the plain, especially on Someş, where the difference from one year to a maximum flow with minimum flow is high, the amplitude being of 132.225 hence the amount of water intake that it brings this plain river compared to the smaller rivers from the studied area.

There is observed a growing trend on the rivers of the northern plain, in the Turu basin (Tur and Turt), a slight increase in the Crasna basin, stationary on Talna and Someş River, a tendency to reduce leakage is evident in the basin Ier (Ier, Santau), and a visible trend of declining of mean annual flow on the Vinului, induced by water deficit that was specific for many years in the last decade of last century and also the low flows recorded on the left tributary of the Someş.

3. Results and Discussion

Increasing flow while is increasing the relief altitude highlights different share of relief levels at an average volume of liquid flow.

It should be noted that almost the entire volume of water drained (79.6%) on the rivers from Someş Plain comes from the altitude range between 101-150 m.

Compared to this average situation appear differences in the main subdivisions of the Someş Plain, and the subunits belonging to them. Thus, in the Low Plain on the level of relief mentioned is made 99.5% from the annual average volume, while in the High Plain the amount of drained water in the same range of altitude is only 59.7% from the annual volume, situation due in first that the most part of the Plain, 2200 km^2 from 3600 km^2 is situated between the altitude 100-150 m range.

Distribution of average flow on the altitude ranges from subunits of Low Plain is observed that in all cases an outstanding contribution to the formation of multi-annual average volume is in the interval of 101-150 m.

In the Ierului Corridor, from Ierului Plain, in the altitude range between 50 - 100 m there is a 5.6% share of total water drained, the only subdivision overlay in a small part of this range, here recorded lowest altitude throughout the Somes Plain, 98m.

The biggest drained volume of water from the Low Plain is registered in Satu Mare-Micula Plain (34.315 million m^3), which is crossed by the largest river from the plain, named Someş.

In High Plain the significant share is in the range of 151-200 m in Ardudului Plain, Tăşnad Plain and Buduslăului Plain with close values between 50.6% and 59.5% from the volume of drained water instead in the Pirului Plain the proportion is between 100-150 m (49.6%) and across Carei-Valea lui Mihai Plain, the largest share is held between 201-250 m (50%) from the total volume of drained water.

4. Conclusions

In a land of plains with small deviation of variation of relief altitude, at first not noticed the evident differences in the territorial distribution of the main components of the balance sheet. Correlations between average altitude of catchments and the hydric balance components reveal the basic laws of formation of water resources in Someş Plain.

Nuances that occur in the spatial distribution of rainfall and flow in the plain are imposed mainly by **the movement of air masses** and **features** of **the landscape** [5]**.**

Geographical location from the northwest of Romania, in the interior of Carpathian Mountains, in north-eastern of Tisa Plain and belonging to the general atmospheric circulation throughout the European space are thus the main elements of position that determine the climate of Someş Plain.

The general circulation of air masses is determined by atmospheric action centres that are characteristic for this part of Europe (Azores anticyclone, Iceland cyclone, Greenland anticyclone, Mediterranean cyclones and North African anticyclone), which in one way or another, affect plain climate at various times of the year.

Given the observed general tendency at the level of the European rivers, in Romania, there is a different pattern in the response of the river beds through the fact that, even if the deepening process is dominant, the aggradation of the river beds still affects numerous sectors of the river.

As a result of geological structure and to the vast areas of plains, accompanied by significant amounts of rainfall rather, **groundwater,** are well represented throughout the Someş Plateau by both components, *deep* respectively *groundwater*.

Subject to more moist air advection and to particularities of a active surface, including **topography** with dominant role (which determined that it is the main element taken into account in spatial analysis of hydric balance component), spatial distribution analysis of the main components of the balance sheet was made at different elevation levels in the main pools and at the level of geographic subunits of the plain.

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